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10/051,479	01/18/2002	Krishnamurthy Ganesan	24.0846	1466

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EXAMINER	
VARGAS, DIXOMARA	
ART UNIT	PAPER NUMBER
2859	

DATE MAILED: 11/28/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/051,479	GANESAN, KRISHNAMURTHY	
	Examiner	Art Unit	
	Dixomara Vargas	2859	

-- Th MAILING DATE of this communication appears on th cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 October 2003*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-62,64-67,69,70 and 72-76* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-62,64-67,69,70 and 72-76* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *06/12/03*.
4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1-20, 28-30, 33-42 and 60-76 are rejected under 35 U.S.C. 102(e) as being anticipated by Sun et al. (US 6,522,137).

The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

With respect to claims 1 and 65, Sun discloses a method for nuclear magnetic resonance imaging of an investigation region of formation surrounding a wellbore, comprising the steps of (Abstract): applying a series of non-linear magnetic field gradients (as seen on figures 7, 9, 11 and 12 showing time varying gradients) to phase encode nuclei spins within the investigation region, wherein the strength of the magnetic field gradient applied is different from at least one previously applied magnetic field gradient within the series (Column 6, lines 27-64); and

detecting nuclear magnetic resonance signals from the investigation region resulting from the series of magnetic field gradients (Column 3, lines 2-13).

3. With respect to claim 2, Sun discloses the step of mapping the signals to one or more angular segment of the formation around the wellbore (Column 13, lines 15-36).

4. With respect to claims 3 and 67, Sun discloses the step of mapping the signals to one or more radial segment of the formation around the wellbore (Column 13, lines 15-36).

5. With respect to claims 4 and 70, Sun discloses the step of mapping the signals to one or more axial segment of the formation around the wellbore (Column 13, lines 15-36).

6. With respect to claim 5, Sun discloses the step of applying a static magnetic field circumferentially around the wellbore and into the investigation region (Column 4, lines 31-42).

7. With respect to claim 6, Sun discloses the step of applying a RF magnetic field circumferentially around the wellbore and into the investigation region (Column 4, lines 31-42).

8. With respect to claim 7, Sun discloses the step wherein each of the magnetic field gradients of the series of magnetic field gradients are oriented circumferentially into the investigation region relative to the wellbore (Column 4, lines 8-31).

9. With respect to claim 8, Sun discloses the step wherein the series of magnetic field gradients are oriented radially into the investigation region relative to the wellbore (Column 4, lines 8-31).

10. With respect to claim 9, Sun discloses the step wherein the series of magnetic field gradients are oriented axially into the investigation region relative to the wellbore (Column 4, lines 8-31).

11. With respect to claim 10, Sun discloses the step of inducing a plurality of spin-echo signals from selected nuclei in the investigation region of the formation (Column 3, lines 2-14).

12. With respect to claim 11, Sun discloses the step of canceling the applied magnetic field gradient prior to applying a magnetic field gradient for the next spin-echo signal (Column 7, lines 24-32).

13. With respect to claims 12 and 61, Sun discloses the step of generating a sequence of pulses and spin-echoes, including gradient pulses from a single gradient coil that provides an azimuthally resolved image of a portion of the formation (Column 3, lines 2-14).

14. With respect to claim 13, Sun discloses the step of generating a sequence of pulses and spin-echoes that provides a radially resolved image of a portion of the formation (Column 3, lines 2-14).

15. With respect to claim 14, Sun discloses the step of generating a sequence of pulses and spin-echoes that provides an axially resolved image of a portion of the formation (Column 3, lines 2-14).

16. With respect to claims 15 and 38, Sun discloses the step wherein during a single pulse sequence, the step of generating a sequence of pulses and spin-echoes comprises the steps of:

i) During a first time period, applying a first RF pulse and a first gradient pulse in the investigation region and measuring the generated signals in the investigation region;

ii) Canceling the first gradient pulse;

iii) During a second time period, applying a second RF pulse and a second gradient pulse in the investigation region and measuring the generated signals in the investigation region,

wherein the second gradient pulse has an amplitude that is incremented from the first gradient pulse (Column 6, lines 46-64).

17. With respect to claims 16, 33-35, 37, 41 and 62, Sun discloses the steps of generating a first pulse sequence comprising a plurality of phase alternated RF pulses, a first set of incremented phase altering gradient pulses and a first set of spin-echoes and generating a second pulse sequence comprising a plurality of phase alternated RF pulses, a second set of incremented phase altering gradient pulses, and a second set of spin-echoes, the first and second pulse sequence being sufficient to derive an azimuthal image of the formation surrounding the well bore (Figures 4-18, 20-28, 31-33 and 35-37).

18. With respect to claim 17, Sun discloses the step wherein the first set of incremented phase altering gradient pulses is generated from a first gradient coil and the second set of incremented phase altering gradient pulses is generated from a second gradient coil, wherein the second gradient coil is angularly spaced from the first gradient coil within the wellbore, defining a gradient coil phase angle (Column 11, lines 36-55).

19. With respect to claim 18, Sun discloses the step wherein the image of the formation mapped from the nuclear magnetic resonance signals from the investigation region has an azimuthal resolution substantially equal to the gradient coil phase angle (Column 3, lines 2-14).

20. With respect to claim 19, Sun discloses the step processing the detected nuclear magnetic resonance signals to optimize the formation image (Column 4, lines 8-21).

21. With respect to claim 20, Sun discloses the step of detecting the nuclear magnetic resonance signals while drilling into the formation (Columns 13 and 14, lines 60-67 and 1-10 respectively).

22. With respect to claim 28, Sun discloses the steps of providing a plurality of gradient means positioned around the circumference of a logging device and selecting at least one of the gradient means to apply the magnetic field gradient to the formation (Figures 3 and 13, #54).

23. With respect to claims 29 and 74, Sun discloses the step of simultaneously applying the gradient pulses from two or more gradient means to phase encode nuclei spins within the investigation region (Column 4, lines 8-22).

24. With respect to claims 30 and 75, Sun discloses the step of controlling the amplitudes of the two or more gradient means to produce a cumulative gradient pulse effect, and defining an equivalent gradient coil phase angle (Column 6, lines 46-64).

25. With respect to claims 36, 60, 66, 69 and 72, see rejection of claims 1-12 above.

26. With respect to claim 39, Sun discloses the step of applying a fixed wait time between applying the RF pulse and the gradient pulse (Figure 1).

27. With respect to claim 40, Sun discloses the step of applying a variable wait time between applying the RF pulse and the gradient pulse (Column 2, lines 18-50).

28. With respect to claim 42, Sun discloses the step of controlling the amplitudes of the two or more gradient means to produce a cumulative gradient pulse effect (Column 6, lines 46-64).

29. With respect to claim 64, Sun discloses the at least one gradient means comprises two gradient coils positioned approximately perpendicular to each other (Figure 13).

30. With respect to claim 73, Sun discloses the step wherein the strength of the magnetic field gradient of greatest amplitude is chosen so that, when the magnetic field gradient is applied, it is at least strong enough to induce a phase difference between adjacent angular distance segments of at least 180 degrees (Columns 5 and 6, lines 21-67 and 1-67 respectively).

31. With respect to claim 76, Sun discloses two gradient coils located perpendicular to each other (Figure 13).

Claim Rejections - 35 USC § 103

32. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

33. Claims 21-27, 31, 32 and 43-59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sun et al. (US 6,522,137) in view of Ganesan et al (US 6,326,784).

With respect to claims 21, 26 and 27, Sun discloses the claimed invention as stated above in paragraph 5 except for the step of partitioning the detected signals into a plurality of bins. However, Ganesan discloses partitioning the detected signals into a plurality of bins (Columns 12 and 17, lines 6-15 and 12-20 respectively). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use Ganesan's teachings in regards to the step of partitioning the detected signals into a plurality of bins with Sun method for nuclear magnetic resonance imaging of an investigation region of formation surrounding a wellbore for the purpose of acquiring azimuthal data of the region of interest in the formation wherein each bin represents the measured signals from at least an angular distance segments.

34. With respect to claims 22, 24, 32 and 44, Sun discloses the claimed invention as stated above in paragraph 5 except for the step of partitioning a cross-section of the formation into a plurality of angular distance segments wherein each bin represents the measured signals from at

least one of the angular distance segments. However, Ganesan discloses the step of partitioning a cross-section of the formation into a plurality of angular distance segments wherein each bin represents the measured signals from at least one of the angular distance segments (Columns 12 and 17, lines 6-15 and 12-20 respectively). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use Ganesan's teachings in regards to the step of partitioning the detected signals into a plurality of bins with Sun method for nuclear magnetic resonance imaging of an investigation region of formation surrounding a wellbore for the purpose of acquiring azimuthal data of the region of interest in the formation wherein each bin represents the measured signals from at least an angular distance segments.

35. With respect to claims 23, 31 and 43, Sun discloses the step of solving a series of Fourier transforms of the detected nuclear magnetic resonance signals (Column 6, lines 20-22). Also, Sun discloses the claimed invention as stated above in paragraph 5 except for the step of partitioning the Fourier transforms into a plurality of bins. However, Ganesan discloses partitioning the detected signals into a plurality of bins (Columns 12 and 17, lines 6-15 and 12-20 respectively). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use Ganesan's teachings in regards to the step of partitioning the detected signals into a plurality of bins with Sun method for nuclear magnetic resonance imaging of an investigation region of formation surrounding a wellbore for the purpose of acquiring azimuthal data of the region of interest in the formation wherein each bin represents the measured signals from at least an angular distance segments.

36. With respect to claims 25, 46 and 55, Sun discloses the step wherein the strength of the magnetic field gradient of greatest amplitude is chosen so that, when the magnetic field gradient

is applied, it is at least strong enough to induce a phase difference between adjacent angular distance segments of at least 180 degrees (Columns 5 and 6, lines 21-67 and 1-67 respectively).

37. With respect to claim 45, see rejection of claims 4 and 21 above.

38. With respect to claims 47 and 48, se rejection of claims 5 and 21 above.

39. With respect to claims 49 and 50, see rejection of claims 6 and 21 above.

40. With respect to claim 51, see rejection of claims 1-10 and 21-22.

41. With respect to claim 52, see rejection of claims 12 and 16 above.

42. With respect to claim 53, see rejection of claims 3 and 16 above.

43. With respect to claim 54, sec rejection of claims 4 and 16 above.

44. With respect to claim 56, see rejection of claim 29 above.

45. With respect to claim 57, sec rejection of claim 30 above.

46. With respect to claims 58 and 59, see rejection of claims 1, 21 and 22 above.

Response to Arguments

47. Applicant's arguments filed October 15, 2003 have been fully considered but they are not persuasive.

48. Applicant argues that the prior art fails to teach or fairly suggest the gradient field to be non-linear.

49. The examiner disagrees with applicant's argument because the prior art discloses gradient pulses varying in time as shown in the Figures 7, 9, 11 and 12 which are considered to be the claimed non-linear gradient field.

50. In addition, applicant argues the following:

a. With respect to claims 11 and 15, Sun does not teach or suggest Applicant's gradient dephasing sequence.

b. With respect to amended claims 12 and 61, Sun does not teach or suggest azimuthal imaging using a single gradient coil.

c. With respect to amended claims 16, 37 and 62, Sun does not teach or suggest deriving an azimuthal image from two pulse sequences.

51. In regards to applicant's arguments above, the examiner disagrees in view of the rejection above for each corresponding claim.

Conclusion

52. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

53. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The additional prior art cited in the PTO 892 discloses logging tools NMR systems with time varying gradients.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dixomara Vargas whose telephone number is (703) 305-5705. The examiner can normally be reached on 8:00 am. to 4:30 pm..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Diego Gutierrez can be reached on (703) 308-3875. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9306 for regular communications and (703) 872-9306 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Dixomara Vargas
Art Unit 2859
November 20, 2003

Diego Gutierrez
Supervisory Patent Examiner
Technology Center 2800